

REMARKS

This Amendment is filed in response to the Office action dated December 26, 2007. All rejections and objections are respectfully traversed.

Claims 1 – 15, 19 – 20, 23-39, and 40 – 42 are in this case.

Claims 1, 5, 27, and 35 have been amended to better claim the invention.

Claim 40 – 42 has been added to better claim the invention.

Request for Interview

The Applicant respectfully requests a telephonic interview with the Examiner after the Examiner has had an opportunity to consider this Amendment, but before the issuance of the next Office Action. The Applicant may be reached at 617-951-2500.

Claim Objections

At page 2 of the Office Action, claims 1, 5, 27, and 35 were objected to because of various informalities. Applicant respectfully submits that the amendment to claims 1, 5, 27, and 27 satisfy the objections.

Claim Rejection – 35 USC §102

At paragraph 5 of page 3 of the Office Action claims 23, 31, and 39 were rejected under 35 USC §102(e) as being anticipated by Cameron et al., U.S. Patent No. 7,165,156, issued on January 16, 2007 (hereinafter “Cameron”).

Applicant’s claimed invention, as set forth by independent claim 23, comprises in part:

23. A method for operating a data storage system, comprising:
creating a writable virtual disk (vdisk) at a selected time, the *writable vdisk referencing changes in data stored in the data storage system after the writable vdisk was created, the writable vdisk having a plurality of holes where each hole is at a location referencing data which has not been changed since the writable vdisk was created*;
maintaining a backing store, the backing store referencing the data stored in the data storage system which has not been changed since the writable vdisk was created;
searching each field of the writable vdisk for a hole; and
referencing each hole in the writable vdisk to point to the data block referenced by the corresponding backing store indirect block to update the writable vdisk to reference both the data which is unchanged since the writable vdisk was created and the data which has been changed since the writable vdisk was created.

Cameron discloses a system and method that adds new data to a snapshot, and preserves the old data using a COW to copy the old data to a ROSS. (See Cameron, Col. 7, Lines 13-59). Specifically, the methodology of Cameron is as follows.

First: Cameron receives a new write request to a data block. (See Cameron, Col. 7, Lines 21 – 24).

Second: Cameron “traverses the address tables of the ROSS” to determine if the data block is in the ROSS, and if it is not, this new write request is deemed to be the first write to the data block.

Third: If the new write request is the first write request, Cameron invokes a COW operation that copies the contents of the data blocks from the RWSS (or an earlier parent or the base) to the ROSS, and writes the new data to the RWSS. (See Cameron, Col. 7, Lines 36-39).

Fourth: If the new write request is not the first write request, Cameron simply writes the new data to the RWSS. (See Cameron, Col. 7, Lines 34 – 35).

Applicant respectfully submits that Cameron fails to teach or suggest Applicant's claimed novel

. . .
writable vdisk referencing changes in data stored in the data storage system after the writable vdisk was created, the writable vdisk having a plurality of holes where each hole is at a location referencing data which has not been changed since the writable vdisk was created; .

. . .
searching each field of the writable vdisk for a hole; and
. . .

Said differently, Applicant respectfully submits that Cameron does not have a vdisk which he searches for a hole. **Further, Applicant respectfully notes that Applicant claims writing new data to the vdisk and also searching that vdisk for holes. Thus, Applicant's claimed invention is writing to the same device that he is searching for a hole. Quite differently, Cameron writes the new data to the RWSS and searches the ROSS for data blocks by traversing the address tables associated with the ROSS. Thus Cameron is writing to a different device than he is searching.**

Further, the Examiner makes the following assertions in the Office Action:

A. "It should also be noted that 'RWSS 202' is analogous to the 'writable vdisk'" and "It should be noted that 'ROSS 204-J is analogous to the 'backing store'." (See Office Action, Paragraph 5, Page 3 – 4).

B. “[i]n effect all the ‘holes’ (i.e. blocks) in RWSS 204 are ‘searched’ in order for each hole/block in RWSS 204 to be properly referenced to point to the corresponding block referenced by ROSS 204-j.” (See Office Action, Page 4, Second Full Paragraph).

Applicant respectfully disagrees with the Examiner’s assertions and will discuss them in detail below.

A. Cameron’s RWSS 202 is NOT analogous to Applicant’s claimed writable vdisk

The Examiner urged

“‘RWSS 202’ is analogous to the ‘writable vdisk.’ Lastly, it should also be noted that for a distinct period of time between when RWSS 202 is created and when RWSS 202 receives its first write, RWSS is completely filled with all ‘holes’.” (See Office Action, Paragraph 5, Pages 3 and 4).

Applicant respectfully disagrees. Specifically, RWSS is NOT completely filled with all holes. Instead, the RWSS is a file full of snapshot data. This is fully supported in Cameron at Col. 7, Lines 36-42 which states,

“the storage management program invokes a COW operation to copy the contents of the data blocks to the ROSS in the following manner. The storage management program first tries **to read the data block from the RWSS....Once the blocks have been read, the storage management program writes the data blocks to the ROSS.**”

The cited text above clearly states that the data is copied from the RWSS to the ROSS. Therefore, it would be impossible for the RWSS to be “completely filled with all ‘holes’” at any time as asserted by the Examiner. Said differently, if the RWSS was full of ‘holes’ as suggested by the Examiner, the copy from the RWSS to the ROSS could not occur.

Furthermore, Cameron describes the RWSS, stating that “RWSSes can be **read and written like a base volume.**” (See Cameron, Col. 2, Lines 63-65). Therefore, it would be impossible for the RWSS to be completely filled with ‘holes’ because if it was, no read operation could be performed because there would be no data.

Therefore, the RWSS IS NOT filled with ‘holes’ but is instead merely filled with snapshot data. In short, Applicant’s claimed system has a vdisk that referencing changes in data stored in the data storage system after the writable vdisk was created, while the RWSS of Cameron is a file filled with snapshot data.

Accordingly, Applicant respectfully submits that Cameron’s RWSS is not analogous to Applicant’s vdisk and thus Cameron fails to teach or suggest Applicant’s claimed novel

writable vdisk referencing changes in data stored in the data storage system after the writable vdisk was created, the writable vdisk having a plurality of holes where each hole is at a location referencing data which has not been changed since the writable vdisk was created

B. Cameron’s does NOT search RWSS 204 in order for each hole/block in RWSS 204 to be properly referenced.

The Examiner urged

“in effect all the ‘holes’ (i.e. blocks) in RWSS 202 are ‘searched’ in order for each hole/block in RWSS 202 to be properly referenced to point to the corresponding blocks referenced by ROSS 204-j.” (See Office Action, Paragraph 5, Page 4).

Although Applicant disagrees with the Examiner’s contention that Cameron’s RWSS 204 is analogous to Applicant’s vdisk, even if we assume RWSS 204 is analogous to Applicant’s vdisk, Cameron does not search RWSS 204 for holes.

Instead, Cameron traverses the address tables of the ROSS 204-j. That is, a write request is received at RWSS 204, and then to determine if the new data is the first write to the data blocks in the RWSS, **the program in Cameron traverses the address tables of the ROSS 204-j**. This is clearly supported by the Cameron specification that states,

“program determines if this is the first write to the data blocks...by searching for data blocks in the most recently created snapshot (**e.g., by traversing the address tables associated with ROS 204-j**).” (See Cameron, Col. 7, Lines 25-31).

Therefore, the search performed in Cameron occurs upon the ROSS and NOT on the RWSS as the Examiner contends.

Furthermore, Applicant respectfully notes **that the Examiner has asserted that Cameron’s RWSS 202 is analogous to Applicant’s vdisk** and Cameron’s ROSS 204-j is analogous to Applicant’s backing store (Applicant respectfully disagrees for the reasons asserted under section A). (See Office Action, Page 4). Therefore, because Applicant searches its vdisk for holes, Applicant submits that the only logical contention that the Examiner can make is that Cameron’s RWSS 202 searches for holes. Said differently, based on the Examiner’s assertion regarding analogous elements between Applicant’s claimed invention and Cameron, it would be illogical to assert that Cameron teaches Applicant’s claimed invention because Cameron searches ROSS 204-j for holes.

That is, the vdisk in Applicant’s claimed invention, which has the new data written to it, is the same device that is searched for holes. Therefore, the only logical assertion that the Examiner can make would be that Cameron’s RWSS searches for holes.

However, as explained above, Cameron's RWSS is NOT searched for holes, but instead Cameron traverses the tables associated with the ROSS.

Accordingly, Applicant respectfully submits that Cameron fails to teach or suggest Applicant's claimed novel

searching each field of the writable vdisk for a hole;

C. Cameron's ROSS 204-j does NOT teach Applicant's claimed invention.

Moreover, even if we disregard the Examiner's contention regarding analogous elements (i.e. RWSS 202 is analogous to Applicant's vdisk and ROSS 204-j is analogous to Applicant's backing store) and assume that the Examiner intended to assert that Cameron's ROSS 204-j is analogous to Applicant's vdisk, Applicant respectfully submits that Cameron still fails to teach or suggest Applicant's claimed novel

referencing each hole in the writable vdisk to point to the data block referenced by the corresponding backing store indirect block to update the writable vdisk to reference both the data which is unchanged since the writable vdisk was created and the data which has been changed since the writable vdisk was created.

That is, even if we assume that the Examiner intended to assert that ROSS 204-j of Cameron is analogous to Applicant's vdisk, Applicant respectfully submits that the ROSS 204-j in Cameron DOES NOT contain *the data which has been changed since the writable vdisk was created*. As is clearly disclosed in Cameron, when a write request to the RWSS 202 is received, the program in Cameron traverses the address tables associated with ROSS 204-j. (See Cameron, Col. 7, Lines 13 and Lines 25-29). If the blocks cannot be found in the ROSS 204-j, then this is the first write to those blocks and the pro-

gram invokes a COW operation to copy the contents of the data blocks to the ROSS. (See Cameron, Col. 7, Lines 36-39). Therefore, the ROSS only contains the original data that was in the RWSS and DOES NOT contain the data which has been changed.

Instead, the RWSS 202 contains the data which is changed (i.e. the write). In short, Cameron discloses a system where the ROSS 204-j contains only the original data and DOES NOT contain the changed data. Therefore, Applicant respectfully submits that Cameron fails to teach or suggest Applicant's claimed invention because ROSS 204-j DOES NOT *reference both the data which is unchanged since the writable vdisk was created and the data which has been changed since the writable vdisk was created.*

Claim Rejection – 35 USC §103

At paragraph 8 of page 6 of the Office action claims 1-15, 19, 20, 24-30, and 32-38 were rejected under 35 USC §103(a) as being anticipated by Cameron in view of Haskin et al., U.S. Patent Publication No. 2003/0158863 (hereinafter "Haskin").

Applicant's claimed invention, as set forth by independent claim 1, comprises in part:

1. A method for operating a data storage system, comprising:
creating a writable virtual disk (vdisk) at a selected time, the writable vdisk *referencing changes in data stored in the data storage system after the writable vdisk was created, the writable vdisk having a plurality of holes where each hole is at locations referencing data which has not been changed since the writable vdisk was created;*
maintaining a backing store, the backing store referencing data stored in the data storage system which has not been changed since the writable vdisk was created;

loading blocks of the writable vdisk from a disk into a memory, the loaded blocks including a writable vdisk indirect block having a plurality of fields, each field storing a valid pointer to a data block or an invalid pointer representing a particular hole of the plurality of holes;

loading blocks of the backing store from a disk into the memory, the loaded blocks including a backing store indirect block having a plurality of fields, each backing store indirect block field corresponding to a field of the writable vdisk indirect block, one or more backing store indirect block fields having a pointer to a data block;

searching each field of the writable vdisk indirect block for a hole; and

replacing each field having a hole in the writable vdisk indirect block with a new pointer to the data block referenced by the corresponding backing store indirect block field to update the writable vdisk to reference both the data which is unchanged since the writable vdisk was created and the data which has been changed since the writable vdisk was created.

Cameron discloses a system and method that adds new data to a snapshot, and preserves the old data using a COW to copy the old data to a ROSS. (See Cameron, Col. 7, Lines 13-59).

Haskin discloses a system and for providing a file system snapshot with a ditto address feature. (See Haskin, Par. [0012])

Applicant respectfully submits that Cameron and Haskin, either alone or in combination, fail to teach or suggest Applicant's claimed novel

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referencing changes in data stored in the data storage system after the writable vdisk was created, the writable vdisk having a plurality of holes where each hole is at locations referencing data which has not been changed since the writable vdisk was created; . . .

searching each field of the writable vdisk indirect block for a hole; and
. . . .

More particularly, for the same reasons asserted under 102 analysis, Applicant respectfully submits that Cameron fails to teach Applicant's claimed novel *referencing changes in data stored in the data storage system after the writable vdisk was created, the writable vdisk having a plurality of holes where each hole is at locations referencing data which has not been changed since the writable vdisk was created; . . . searching each field of the writable vdisk indirect block for a hole.*

Moreover, Applicant respectfully submits that Haskin is silent with respect to the same feature of Applicant claimed invention. In fact, the Applicant respectfully notes that in the Office Action provided by the Examiner, the Examiner **NEVER** contends that Haskin teaches Applicant's claimed novel *referencing changes in data stored in the data storage system after the writable vdisk was created, the writable vdisk having a plurality of holes where each hole is at locations referencing data which has not been changed since the writable vdisk was created; . . . searching each field of the writable vdisk indirect block for a hole.*

Accordingly, Applicant respectfully submits that that Cameron and Haskin, either alone or in combination, fail to teach or suggest Applicant's claimed novel

. . . .
referencing changes in data stored in the data storage system after the writable vdisk was created, the writable vdisk having a plurality of holes where each hole is at locations referencing data which has not been changed since the writable vdisk was created; . . .
searching each field of the writable vdisk indirect block for a hole; and
. . . .

NEW CLAIM

Applicant's claimed invention, as set forth by independent claim 40, comprises in part:

40. (New) A method for operating a data storage system, comprising:
- creating a writable virtual disk (vdisk) at a selected time, *the writable vdisk referencing changes in data stored in the data storage system after the writable vdisk was created, the writable vdisk having a plurality of holes where each hole is at a location referencing data which has not been changed since the writable vdisk was created;*
 - maintaining a backing store, the backing store referencing the data stored in the data storage system which has not been changed since the writable vdisk was created;
 - searching, by a background task process, each field of the writable vdisk for a hole;* and
 - referencing each hole in the writable vdisk to point to the data block referenced by the corresponding backing store indirect block to update the writable vdisk to reference both the data which is unchanged since the writable vdisk was created and the data which has been changed since the writable vdisk was created.

Applicant respectfully submits that for the same reasons asserted under the 102 the 103 analysis, Cameron fails to teach or suggest Applicant's claimed invention.

Furthermore, Applicant's claimed invention can run in the background, while Cameron must search in real time. (See Cameron, Figure 7). Cameron's search therefore has a negative impact on client throughput.

In stark contrast, Applicant search has no impact on real time client throughput as it runs in the background without any downtime visible to the client. (See Applicant's Specification, Page 24, Lines 21 – 29).

Accordingly, Applicant respectfully submits that Cameron fails to teach or suggest Applicant's claimed novel

searching, by a background task process, each field of the writable vdisk for a hole

All independent claims are believed to be in condition for allowance.

All dependent claims are dependent from independent claims which are believed to be in condition for allowance. Accordingly, all dependent claims are believed to be in condition for allowance.

Favorable action is respectfully solicited.

Please charge any additional fee occasioned by this paper to our Deposit Account No. 03-1237.

Respectfully submitted,

/A. Sidney Johnston/
A. Sidney Johnston
Reg. No. 29,548
CESARI AND MCKENNA, LLP
88 Black Falcon Avenue
Boston, MA 02210-2414
(617) 951-2500